

Appl. No. 10/687,183
Amdt. Dated 08/03/2005
Response to Office Action of 05/04/2005

Attorney Docket No.: TS03-120
N1085-90157

REMARKS/ARGUMENTS

Claims 1-52 are pending in this Application and claims 1-33 have been withdrawn from present consideration. Claims 34-52 have been rejected. Claims 34,
5 38, 45 and 48 are hereby amended and Applicants respectfully request allowance of each of claims 34-52 based on the amendments and remarks provided below.

On page 2 of the Office Action, claims 34-52 were rejected under 35 U.S.C. §103(a) as being unpatentable over Lin (USPN 6,093,656) in view of Sugai (USPN 6,569,756). It is believed that claims 34-52 are distinguished from the references of
10 record for reasons set forth below.

Amended independent claim 34 recites the feature of a copper interconnect structure with a first copper layer and a second copper layer formed in an opening, the second copper layer over the first copper layer, and in which each of the first copper layer and the second copper layer have vertical sidewalls that extend along the
15 sidewalls of the opening. In particular, claim 34 recites:

"a first copper layer having first vertical sidewalls . . . formed in a opening . . . said first vertical sidewalls disposed along sides of said opening", and

20 "a second copper layer disposed in said opening and having second vertical sidewalls disposed along said sides of said opening. . . and a convex bottom surface that forms an interface with said concave top surface of said first copper layer."

Clearly, both the first and second copper structures are formed in the same
25 opening and each have sidewalls that extend along the same (trench) sidewalls

Amended independent claim 45 similarly recites the features of a copper interconnect structure formed in an opening and in which a first copper layer and a second copper layer formed over the first copper layer, are disposed in the same

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opening and each have sidewalls that extend along the same sidewall of the opening.
In particular, amended independent claim 45 recites:

"a first copper layer . . . having . . . first vertical sidewalls that
are disposed along said trench sidewalls;" and

5 "a second copper layer . . . having second vertical sidewalls
that are disposed along said trench sidewalls . . . and a
convex bottom surface that forms an interface with the
concave top surface of the first copper layer."

Claim 45 therefore also recites two copper structures in the same trench
10 opening, one over the other, and in which vertical sidewalls of each of the copper
structures each extend along the same trench sidewall.

Neither of the references teach or suggest these features. The Lin reference,
does not teach a second copper layer at all. The Examiner refers to "second copper
layer (18) having vertical sidewalls", but Applicants respectfully point out that feature 18
15 of Lin is a concave surface, not a copper structure. Column 2, lines 39-43 of Lin recite
"the prior art copper 16 in the wide trench 9 has a concave surface or dishing 18. This
dishing 18 is due to the high polishing rate which occurs in the center of wide areas as
compared to narrow areas". Nowhere in the Lin reference is it suggested that there is
copper above line 18 of FIG. 1. As above, and as well known in the art, dishing
20 produces a concave surface and the illustrator of FIG. 1 of Lin chose to include cross-
hatching above the dishing line to illustrate that the surface 18 is concave and that the
periphery of copper 16 as visible in the cross section, includes copper at the periphery
of trench 9. Applicants respectfully submit that it is well known in the art that dishing
creates a concave surface and that the dished material, i.e. copper, extends to the top
25 of the trench in peripheral areas but includes a reduced thickness towards the center of
the trench and that one of ordinary skill would understand FIG. 1 to illustrate as much.
Also, Lin never refers to a second copper material in the trench because there is none.
"Dishing 18" refers to a concave surface, not a further copper structure. Lin therefore
does not disclose two copper materials formed in a trench, much less two copper
30 structures having the distinguishing sidewall features as recited above.

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The cited reference of Sugai has apparently been relied upon for providing a first copper layer having a grain density G_{D1} and a second copper layer having a grain density G_{D2} . The Examiner alleges that, since the copper layers are made by different methods and conditions, they would have different grain densities. Without addressing
5 this contention by the Examiner, even if Sugai did provide copper layers having different grain densities, it would not make up for the above-stated deficiencies of Lin.

Moreover, Sugai does not disclose or suggest the feature, recited in each of independent claims 34 and 45, whereby the second copper layer is formed over the first copper layer and in the same opening, and includes vertical sidewalls that extend along
10 the same vertical sidewalls of the opening as do the vertical sidewalls of the first copper structure. As shown in FIG. 2(c) of Sugai, the second copper thin film 6 does not include sidewalls that extend along the sidewalls of the opening (connecting trench) 3.

Amended independent claims 34 and 45 are therefore distinguished from the references of Lin and Sugai, taken alone or in combination and therefore the rejection of
15 claims 34 and 45 under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of Sugai, should be withdrawn. Claims 35-44 depend from independent claim 34 and claims 46-52 depend from independent claim 45 and are each therefore similarly distinguished from the references of Lin and Sugai, due to their dependency from claims 34 and 45 which are distinguished from the references. Claims 38 and 48 have been
20 amended for consistency with amendments to their base claims.

The rejection of claims 34-52, under 35 U.S.C. §103(a) as being unpatentable over Lin in view of Sugai, should therefore be withdrawn.

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CONCLUSION

Based on the foregoing, each of pending claims 34-52 is in allowable form and the application in condition for allowance, which action is respectfully and expeditiously requested.

The Commissioner is authorized to charge any additional fees and to credit any overpayment of fees which may be required under 37 C.F.R. §1.16 or §1.17, to Deposit Account No 04-1679.

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Respectfully submitted,



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